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Thermally Grafting Aminosilane onto Kenaf-Derived Cellulose and Its Influence on the Thermal Properties of Poly(Lactic Acid) Composites.

ABSTRACT

The effects of thermally grafting hydrolysed 3-aminopropyltriethoxysilane (APS) onto kenaf-derived cellulose and the influence of incorporating them into poly(lactic acid) (PLA) were investigated. Composites containing 30 wt.% cellulose (C) and silane-grafted cellulose (SGC) were melt-blended into PLA before being hot pressed into 0.3-mm films. The silane grafting of cellulose was confirmed via Fourier transform infrared spectroscopy (FTIR) with the presence of Si-O-Si, Si-O-cellulose, -Si-C-, and Si-O-C bonds, and –NH2 groups despite post ethanol washing. Using thermogravimetric analysis (TGA), it was determined that the thermal stability of the cellulose improved by 8 °C after silane grafting. As for the composites, PLA/SGC improved the thermal stability by 12 °C as compared to PLA/C. From differential scanning calorimetry (DSC), adding C into PLA slightly reduced the glass transition temperature, Tg, of the PLA from 59 °C to 57 °C, which remained unchanged with silane grafting. PLA displayed double melting peaks from its melt-recrystallization behaviour. While the final melting temperature at 150 °C was not affected, incorporating C and SGC influenced the intensity of the melting peaks. The significant reduction in crystallisation temperature from 113°C to 102 °C and 105 °C, and the increase in crystallinity by almost two fold, indicated that cellulose was an effective nucleating agent.

Keyword: Poly(lactic acid); Kenaf; Cellulose; Silane coupling agent; Composite; Thermal properties